

International Seminar on Collaboration Research
“Study on Urban Environmental Management of Indonesian Cities Considering
Applicability of ‘Kitakyushu Model’ as Japanese Advanced Eco-model City”



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Study on Urban Environmental Management of Indonesia Cities
Considering Applicability of ‘Kitakyushu Model’ as Japanese
Advanced Eco-model City

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Abstract

Kitakyushu City of Japan has been experiencing to overcome various heavy industrial contamination since couple decades, which referred by many countries in their initial step to solve similar pollution problems. Well-known as center of iron and steel industry in Japan since 1901, the city put environmental cost became ever worst and lead to fallen steadily of city population. Initiated by massive citizen movement on environment management in 1950 and concrete steps of local authority to tackle the issue since then, the city had transform itself from a grey city to a green city in 1980. Awarded as one of eco-model city by United Nations (1992) for its massive citizen movement on environment management, the city take a lead as model city of global partnership based sustainable society to contribute mainly on integrated local society sustainable development toward mature civilization at many cities across Asian countries. As emerging countries, Indonesia has been dealing with pollution, mainly at big cities with various levels. Lesson learnt, experiences how eco-model city cope with the problems, and its adaptability at various aspects in research modes are one of serious solution not only to reduce the similar cases in Indonesia but also to develop body of knowledge in environment management and public education. The research is aimed to describe adaptability of eco-model of Kitakyushu brought by Kitakyushu University with five Universities in Indonesia. Research area was developed under local problems of environment and expertise of each university researchers while eco-model of Kitakyushu employed as best practices and lesson learnt city. The research brought by five Indonesian universities covering river information system management, household oil campaign for biodiesel usage, learning environment for visual impairment students regular students at primary level, and renewable energy development for vocational high school students. Field visit is chosen as a bridge research method to gain adaptability of eco-model Kitakyushu in various research fields. About one month of field visit to various places and focus group discussion with key persons related with eco-model and its stakeholder are applied. The paper describe briefly lesson learnt from each research area and adaptability properties from the eco-model.

Keywords: eco-model city, Environmental education, Environmental issues

1. Introduction

According to RI amendment no. 32/2009 concerning the protection and maintenance of environment, environment definition is a space which consists of all things, sources, and living organism including human and behavior that influence the nature itself, the prosperity of humans and other living organisms. On that amendment, stated that the quality of the environment has been decreasing and threaten human life and other living organisms hence the consistency of protection and maintenance towards environment are needed in order to sustain life.

Nowadays, the environment condition on big cities in Indonesia has been experiencing degradation. The standardized quality has been violated especially on water and air which potent of influencing the life quality of Indonesia society. In order to overcome this issue, it is needed some integrated and detailed solution in every aspects. A fast solution which can be executed so that it can fix the environment quality effectively by taking an example of a successful environment maintenance which is carried by other regions. One of the famous city that has been successfully carrying the environmental maintenance is Kitakyushu in Japan. This city had a terrible history in handling its environment due to the industrial issue. Within 30 years, this town changed to eco-town, an environmental friendly city which has good environmental maintenance concepts in every aspect. With its achievement on maintaining its environment, Kitakyushu becomes a role model which is adapted by other cities

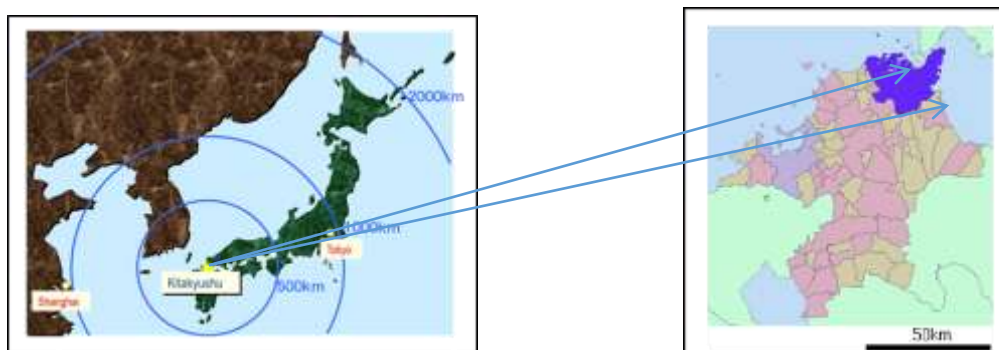
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in many countries to fix the quality of city's environment. Kitakyushu has promoted an international environmental cooperation on several big cities in Asia using its policy and its experiences to overcome the environment pollution seriously. By its conventional policy of maintaining its environment, Kitakyushu is considered as an environmental friendly city especially because of the eco-town project role which attracts the attention of internal source and foreign source.

Kitakyushu as eco-town model

1.1. Kitakyushu's orientation

Kitakyushu as eco-town has 485 km² square lies on the north of Kyushu region. Kitakyushu has become one of the famous regions for heavy industry as iron manufacture and has a valuable experience on solving an environment with serious pollution issue. After a high economic growth in 1950-1970, using heavy industry such as iron manufacture, Kitakyushu's income decreasing because of intensive competition on iron industry in international market. During the industrialization era, the air and water which disembogues into Dokai bay badly polluted. The condition of polluted water by industry and domestic at Dokai bay was very bad and it was called "sea of death" the pollution issue in Kitakyushu needed a quite long time to solve and brings back its clear sky and its blue sea.



Picture 1. Orientation map of Japan country and Kitakyushu coordinate.

Kitakyushu is one of the cities that care for environment. This city started to become the highlight and role model for the developing countries in the world in learning the solution for environmental issue. The city that formed from 6 districts with its population around 970.000 people was an industrial city and international trade with population about one million people when it was formed in February 1963 and it was formed from 5 little towns which are Moji, Kokura, Wakamatsu, Orio, Yahata, and Tobata.

1.2. Kitakyushu's history

Around 1600 AD, for the first time on history, Kitakyushu became a highlighted area. Since the construction of Kokura castle, this region then became prosper and has a role as the town guard of Kyushu Island's commercial area and government.

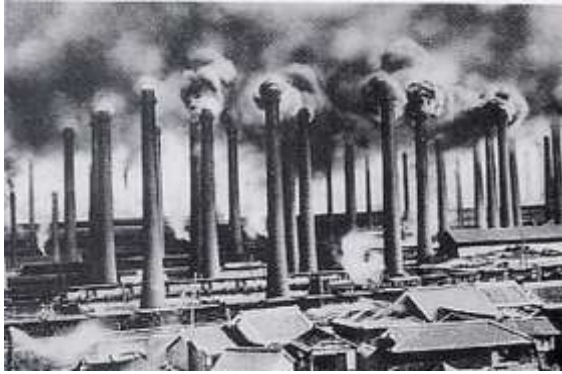
Since the leading by Meiji government in 19 century, this region recorded the advantages of strategic geographical position. It had its prosperity by becoming the main intersection for sea and land. Besides the development of the trading, railways and docking bay rapidly built on the area.

In industrial aspect, Kitakyushu consist of the biggest four industrial area as an industry basis which contributes towards the ability of Japan's manufacture through aggregation material industry such as steel, chemical, metal, and ceramic industry which was started by the government in handling Yahata's steel factory, the biggest steel manufacturer in Asia which was erected in 1901. After that, many kinds of heavy industry and car industry which was related to steel factory erected one by one in this city.

1.3. Industrialization and Contamination

Since industrial revolution took place which was remarked by erecting Yahata steel factory on Tobata district, Kitakyushu became a city which had so many issues regarding on environment. In 1960s, this city was called as "7 colors" for its colorful polluted cloud. On that time, Kitakyushu also had a purple river without fish and vegetation that could live in it. Many kinds of disease especially asphyxiation and itch because of the pollution that affected children and became a break out plague.

1950 until 1970 was a rapid growth for economy that being remarked by heavy industry such as iron manufacture. The effect from industrial development was a serious contamination and intensive competition on iron industry in international market.



Picture 2. Air contamination condition in Kitakyushu



Picture 3. Water contamination condition on Dokai Bay

1.4. Environment Recovery Efforts in Kitakyushu

Started from the concerning parents, especially the mothers who worry about their children, Kitakyushu's citizens starting to realize the danger of contamination and tried to recover the environment condition. Not only the government, but also the citizens, especially women, businessmen, and non-governmental organization, rose up to build the city to become an environmental friendly city. Gradually, the environmental contamination in Kitakyushu lessens from time to time thanks to the efforts for reclaiming its clear sky and blue sea.

From this experience, Kitakyushu built a comprehensive strategy to develop itself and promoted its structural pattern change from heavy industry to environmental recovery industry. Japan government suggested and promoted kinds of activity that related with community based on recycling.



Picture 4. Environmental changes in Kitakyushu during 30 years.

Nowadays, Kitakyushu becomes a role model for environment. Kitakyushu also becomes the center of learning process in solving the environmental issues for other developing countries.

1.5. Kitakyushu's face today.

Kitakyushu has grown to be a friendly green environmental city with many kinds of activity that support and solve environmental issues. Many facilities possessed by this city in order to support the development of friendly environmental city.

Kitakyushu has the most comprehensive eco-town center in Japan. In 1997, eco-town project in Japan was introduced by trading industry department (MITI) that became economy, trading and industry ministry (METI) in 2001. This project's purpose was to promote zero emission to the local and national citizens by creating a new environment for local cities and introduce sophisticated technology for recycling. Kitakyushu eco-town project lies on the east wing of Hibiki landfills in Kitakyushu is the first project which was approved and became a symbolical icon. This project consists of industrial compound with comprehensive environment treatment, Hibiki recycle area, and research practice area.



Picture 5. Eco-town Kitakyushu project scheme

Industrial compound with comprehensive environment treatment makes some company is able to handle and distributes the recycling product to another company. This process is a cycle tie in between raw material and an industrial recycling product which is called recycle chain.

Hibiki recycle area supports micro business which starts to be recycling industry by preparing the business location that can be rented for a long time. Local research council acts as research center and sophisticated environmental technology development.

In 2003, there were 36 organizations which joined on this site. In August 2002, second phase eco-town was planned and developed with 3 R policies (reduce, reuse, recycle). This project particularly aims for developing and promoting environmental industry, especially recycling business as the new industry in Kitakyushu. This project also has a purpose to build a recycle chain community through the collaboration among industries, local government, and customers.

1.6. Bay Water Recovery and Water Quality Management

Dokai Bay Kitakyushu lies on the north side had been called “dead sea” because its water contaminated by dense toxic chemical waste. The movement against contamination was pioneered by the women association and work union in 1960-1970s.

The main act towards water contamination was to dredge the chemical waste from the bottom of the bay. This dredging was executed by the industry which contaminated the area in the first place and the national government, prefecture government, and local government based on polluter pays principle, water quality control act and industrial waste control amendment. The dredging was started in 1974 for one year. Nowadays, Dokai Bay environment has been recovered and it is habituated by 100 kinds of fish and shrimps.

1.7. Solid Waste Management

Waste management in Kitakyushu started in 1950. The main focus was the efficient management, namely the handling and management of hazardous waste and promotes recycling. This city had embarked on implementing policies and projects by following the applicable legal framework for waste disposal and recycling, among other national laws on the Public Area Cleanliness in 1954, Waste Disposal and Public Cleansing Law in 1970, and the Law for the Promotion of Utilization Recycled Materials in 1991.

The city developed a master plan for efficient waste management such as recycling, the process of collecting, transporting process in 1963. Since then, the master plan had been revised several times and the city government then introduced a system using a bag of plastic bags that must be purchased by the public started in 1998, which could cover about 12% of the cost of waste management. The percentage of reassemble recycled resources such as cans, plastic packaging, PET bottles had increased and the city government continued to push through environmental education and public awareness campaigns.

As another major project, Kitakyushu formed eco-industrial complexes and research centers that were approved and supported by Japan's Ministry of Economy and Trade and Industry (METI) as the first city of the "Eco-Town Project" in 1997. Eco-town was aimed for education and research, development, assessment and establishment of new businesses related to recycling technologies, in collaboration with research institutes in Kitakyushu Science and Research Park. Eco-Town is now one of the main places for international environmental cooperation for Kitakyushu because it provides new recycling technologies and the potential for business. Until now, the City of Kitakyushu has received more than 4000 participants from 118 countries and sent about 100 trainers to 25 countries, including 14 countries in Asia.

Kitakyushu program.

Kitakyushu has recently made efforts to enhance the system of solid waste management, reduction of CO₂ emissions, ESD (Education for Sustainable Development), and so on. The city government aimed to reduce 10% of CO₂ based on the number in 2002. The city also imposed a unique system to reduce the amount of plastic packaging and encourage green consumer movement ("Kanpass Seal") since 2006.

1.8. Environmental commitments

As a commitment to environmental hygiene, the city government declared six targets at the fourth meeting of Kitakyushu Initiative Network in 2007.

Kitakyushu City's commitments to be fulfilled in 2010 are:

- a. Kitakyushu city supports the activities for the 'Clean Environment'
- b. Increase the number of training participants that reached 400 people per year
- c. Reducing household waste disposal by 20% and increase the percentage of recycling up to 25%
- d. Reducing CO₂ disposal of 10% of the amount in 2002
- e. Providing 860 pieces of low-emission public transport
- f. Increase the number of volunteers "Eco-Life", a campaign for environmental education, up to 300 people.

Achievements in 2008

- a. Receiving 494 participants in 2007 and 400 participants in 2008;
- b. Achieving a 24% reduction in household waste and 30% increase in the percentage of recycling;
- c. Providing 735 low-emission public transport in 2007
- d. Increasing the number of participants in the "Eco-Life" to 460,000 in 2007.

Kitakyushu city waste generates 1,400 tons / day, with a per capita generation of 1.40kg / person / day and a composition of 40% paper, 20% plastic. Garbage collection now has reached 100%, with a frequency of 2 times per week collection in conditions that has been divided. There are two places centralized recycling, and 3 installation incinerator and a landfill with the type of sanitary landfill.

Budget used by the government to manage the environment in Kitakyushu City was 17.6 billion yen, or about 3.3% of the general budget. Half of the budget came from local revenues, while 12% came from fees derived from the sale of plastic bags of garbage.

1.9. Challenges and Major strategies

Compared with other environmental issues, waste problem is the issue that needs more understanding, participation, and collaboration / partnership of all members of the society. The great potentials for such partnerships are social systems and traditions that are commonly understood by public. To find this potential, discussion forum is required to share experiences about the achievement, failures, contributing factor among local communities, and creating useful system. The selection of the appropriate technology is more effectively determined by the situation of each district in Kitakyushu city.

In dealing with waste, combustion system is used to reduce the volume of waste and to cope with the limited landfill area. The combustion residues are also used to stabilize the reclamation area to avoid the decomposition of organic waste. The economic consideration also becomes the reason for applying the system.

On the waste sorting process, the inhabitants participated actively in recycling the paper products (newspapers, journals, and others). In addition, they separated cans, glass and plastic bottles which were later collected and used as raw materials after the process. Some glass bottles were reused by applying a deposit system. The city government established a subsidy program to promote composting activity for the inhabitants. Currently about 26,526 households have received composting equipment.

Kitakyushu applied the use of clear plastic bag system in 1998. The sale revenue of plastic garbage bags was used to assist and promote environmental activities in the community. The basic process of solid waste management was a consensus with the local community. Environmental management decision-making processes in Kitakyushu were as follows:

1.9.1 The questionnaire to develop dialogues with the inhabitants

1.9.2 Meeting with the inhabitants during the planning phase through cooperation with the environmental community to exchange ideas and information regarding the eligibility and purpose of the retribution system, the benefits and the additional responsibilities of the system that will be implemented

1.9.3 After the agreement became official, the agreement between the inhabitants and government, were set by Kitakyushu to be local regulations

1.9.4 Contributions such as advice and assistance on the programs implementation were opened to the inhabitants, government officials, and volunteers.

On the implementation of the new policy of the effective and efficient locally based waste management, besides it must be created as an agreement, it should also be supported by understanding about the condition of waste, the estimated needs in the future, identification of the problems, steps to solve the problems, the evaluation on the ability, the local stakeholders roles, and the security of all necessary resources.

Solid Waste Management is regarded as one of the most serious environmental aspects faced in urban areas in Asia. The growth of urban population and the economy has caused an increase in solid waste generation; as the result, the local government faces difficulties in managing the waste. The increasing waste generation problem is compounded by the difficulty of finding a new location for landfills. Therefore, the steps that should be taken are to reduce the amount of waste that will be moved to the landfills. The process of composting organic waste is considered not only an effective measure to reduce municipal solid waste, but also to improve and build public awareness of the environment, especially in developing countries with a high proportion of organic wastes which are more than half of the total amount of waste.

Kitakyushu has the experience of solid waste management in Surabaya with the model of composting system. This method was first tested in Kampung Rungkut Lor, an urban community that is adjacent to the largest industrial area in Surabaya, where Non-Governmental Organization (NGO), Pusdakota, with technical assistance provided by the Kitakyushu International Techno-Cooperative Association (KITA) , encouraging people to separate the garbage. The organic waste is collected separately and processed in the closest composting center to adopt Takakura composting method, a simple composting method utilizing locally available goods and fermenting microorganism or local microorganisms.

By leveraging the Kitakyushu Initiative (KI) network for Clean Environment, Kitakyushu City, KITA, and the Institute for Global Environmental Strategies (IGES) have cooperated to share the success of the waste management model in Surabaya to the other cities in Asia. This model has been followed and successfully applied by other city governments. Therefore, Takakura composting method has become a popular technology for recycling organic waste, and Kitakyushu composting system is a model of composting that are known and applicable in many cities.

Besides being known in organic waste management, Kitakyushu is known for its Kitakyushu Eco-Town center; environmental learning center established in June 2001 to promote the deployment of the Eco-Town activities and to raise public awareness of the materials as well as materials on the market. Here are the functions of Eco-town Center:

1. A learning place about the environment for the community
2. A place for environmental training / seminar
3. Giving explanation to visitors
4. Providing support in research activities
5. Conducting comprehensive environmental management for Eco-Town project
6. Means to exhibit the environmental technologies / recycling
7. Means to exhibit/introduce the environmental industry in Kitakyushu

Besides *Eco-town*, Kitakyushu has many facilities that support the achievement of eco friendly city. Figure 8 shows the agencies that support the development of activities related to the environmental management in Kitakyushu.

Strategies to improve the quality of the industry engaged in the environmental field in Kitakyushu cover several aspects i.e. the basic research in the comprehensive development, technology development, as well as practical research and commercialization efforts. Figure 9 shows the strategy.

2. The Problems

2.1. Environmental Issues in Indonesia

There are several important issues related to the environment in Indonesia as follow:

1. Contamination and fluctuation of surface water discharge

River is surface water which is used as the main source of drinking water. Therefore, the quality must be maintained, especially to keep inexpensive processing costs and become reachable by the society. But now, the rivers in big cities in Indonesia are largely contaminated, mainly due to domestic effluent. Industrial and other activities such as hospitals, hotels, restaurant, also contribute to the degradation of water quality.

Besides contamination, problem that arises related to water are water scarcity during the dry season, which resulted in a decrease in drinking water supply for the society. On the other hand, during the rainy season, the runoff is very high due to reduced green land and catchment areas. The high runoff triggered flooding in certain areas as well as material damage



2. *Air pollution*

With the increasingly high electricity prices, many industries conduct independent energy supply by making the power plants that are not eco friendly, i.e. coal usage. Coal combustion causes SO₂ that can lead to lower air quality and acid rain. In addition, air pollution can occur as the result of motor/vehicle fuel/ petrol which is not eco friendly.

3. *Incomplete Waste management*

Good or bad situation of a city is determined by its cleanliness. This is surely related to waste management in the city. Currently there are many cities in Indonesia using conventional methods (gather, transport, waste) in dealing with the waste problem. 3R program has been deployed to the public but has not worked well in addressing the problem of urban waste.



4. *Minimum waste recovery*

Closely related to water pollution and waste management, the volume of both liquid and solid waste is still not much sought for recycling. This is resulted in the environmental burden that is hard to decipher / self-purification.

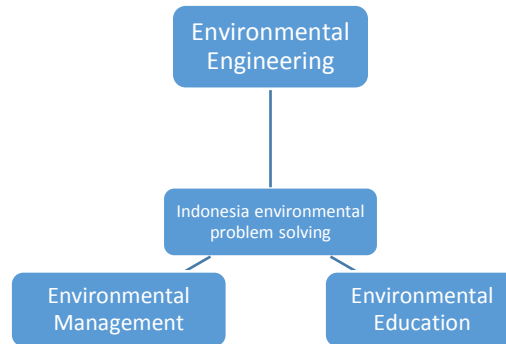
5. *Low public awareness*

As the main roles, human is the main key of good or bad condition of the environment. Low public awareness, accompanied by ignorance and narrow insight caused the poor environment quality in an area. This is compounded by the high competition among individuals in the crowded and impoverished communities.

This poor quality conditions should be fixed by considering various aspects of comprehensive and integrated manner.

3. Environmental Problem Solving Strategies in Indonesia

Environmental problems completion should be done from various aspects, both from the aspect of the human resources, systems / procedures / strategies (software), and technology / device (hardware).



For the aspect of human resources, the involvement and cooperation of each stakeholder are necessary, i.e. government- society -academician-entrepreneur. A policy holder that will govern the environmental management system is the government, while the academicians will be in charge for carrying out their three-dharma namely:

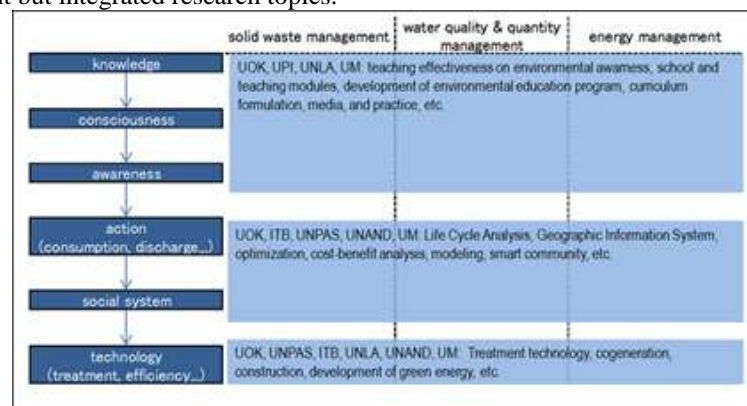
- Providing teaching, educating or conveying information based on scientific theories
- Conducting research on the formation and development of systems / technology / methods
- Providing the research discoveries for public, either in the form of modules /training / system / technology, etc.
- Human resources aspect is also closely related to increasing public awareness for preserving the environment.

The environmental management can be run well if arranged in a comprehensive system equipped with clear procedures and technical instructions. For example, for a waste sorting system, before being implemented, it should be made distribution system for the sorting result and collecting system for each type of disaggregated waste.

In attempt to handle the pollution, it is required the right technology. Moreover, to realize the minimization of waste and pollution potential, it needs a well-engineered recycled liquid and solid waste.

To achieve effective and efficient environmental management and produce healthy and clean environment, it needs to conduct research that covers strategic aspects mentioned above. The success of an environmental management system begins with the provision of information and knowledge to all stakeholders, followed by consciousness and awareness on the importance of protecting the environment. The stage is followed by actions and behaviors, the establishment of social system and supported by technology

The implementation of comprehensive research can be realized with the involvement of a variety of scientific fields. The universities in Indonesia, which have been cooperating with the University of Kitakyushu (UOK), especially the Faculty of Environmental Engineering, are the University of Andalas (UNAND), Pasundan University (UNPAS), Indonesia University of Education (UPI), University of Langlangbuana (UNLA), State University of Malang (UNM), and the Institute of Technology Bandung (ITB). The groups from these several universities will conduct research under the theme about the effort to manage the urban environment in Indonesia using Kitakyushu City Eco-City model. Figure 13 shows the stages in the environment completion, supported by research that will be undertaken by several universities that currently have agreement with the University of Kitakyushu. This study is joint research that will be conducted by six universities with different but integrated research topics.





Here are some topics of each research proposal submitted by each university.

1. Andalas University

- Kitakyushu Eco-town Model for Creating a Sustainable Society in Padang City, Indonesia.
- The Potential of Cooking Oil and Oily Food Wastes as Alternative Biodiesel feed stocks and People Participation for Collecting Them in Padang Municipality

2. Indonesia University of Education

- Role of Community Center as the Non-Formal Education for Environmental Knowledge.
- Instructional Media Development of Environmental Education (EE) Learning for 4th Grade Students in Extra Ordinary School Section "A" In Bandung

3. Pasundan University

Modeling and Information System of River Water Quality-Case Study Cikapundung River Bandung

4. Langlangbuana University

The Apply of Integrated Learning Model in Dealing with the Environmental Life Problem at Primary Schools in Bandung City, West Java, Indonesia

5. The State University of Malang

Education on Renewable Energy and Power Energy Saving Considering Environmental Behavior for Vocational Schools as a Pilot Project in Malang, Indonesia

4. Conclusion

The 5 Universities incorporated in abroad research cooperation, visited and gathered data for two weeks up to a month, in accordance with the needs for obtaining the data and information. Therefore, from the results of the visit and data searching, it was obtained the information- either supporting data or test materials. The findings of the visit to Kitakyushu city are as follows; (each group in accordance with its proposal theme visited a place that will be a model of problem solving.

Andalas University, the team visited the management of existing biodiesel in Kitakyushu area Eco town center. It visited and interviewed in regard to the purpose for creating and using biodiesel. Besides, it visited one of the small neighboring cities named Kitakyushu City Onga- observing the community participation in managing and collecting used oil to be used as biodiesel. The method used by Onga will become a piloted project in Padang and surrounding areas. The community in Onga is supported by the government to launch campaign of used oil collection. Government repeatedly called on the people to participate in protecting the river and water.

Indonesia University of Education. The team of this university visited the learning center for the blind, Braille library. Moreover, the team held discussion with several teachers and teachers assistances for the blind. From the results of this visit, it will be made learning patterns about environmental education for blind people such as waste disposal habit, maintaining the environment and the use of waste. The piloted learning will be conducted in several schools (special need schools) in the city. Then it will be observed whether the environmental education (PLH) method conducted in special needs schools in Kitakyushu can be used in special need school in Bandung. The next activity is to hold a workshop about the method for the teachers in Bandung

Pasundan University, the team researched on how Kitakyushu city managing the river, providing information to the society and giving a role as a medium of education for the Kitakyushu community. The system informational model carried in Kitakyushu city will be piloted in Bandung. Kitakyushu has a river information system model for the society and people with an interest in the use of such information such as those who need the information for research, economy and business. Kitakyushu city government also has the

legal rules governing the system of this information. The following rules are used to maintain the condition of the river.

Langlangbuana University, the team visited various institutions of learning environmental education, such as water museums, environmental museum, and playground, visited a primary school which is a symbol of environmental education schools. Nakatani School is a school that is best known for its environmental education. Furthermore, the team also discussed with PLH (environmental education) teachers and viewed the students' activities photos. Langlangbuana University will carry the environmental education learning methods undertaken in the city of Kitakyushu and pilot it in some primary schools in Bandung. Environmental education conducted in Kitakyushu will be more focused on outside activities and immediately go to the real field. As exemplified by one of the visited schools, they utilize the closet school agricultural land for vegetable planting trials and use the river that they maintain its cleanliness. In addition, these schools also cooperate with the local community in the activities of the environmental education as a knowledge resource.

State University of Malang, with the energy theme, the team accompanied by several people from other teams, analyzed how the vocational technical school learns about energy. How the teachers teach about the natural energy, artificial energy and energy utilization. The teams from the State University of Malang visited three engineering schools in which they use laboratory as an experiment media in learning about energy.

From the results of the visit to the Park energy center in Kitakyushu Eco Town, it can be seen how energy is made, how energy is used and what kind of effect of using too much energy. Furthermore, the researchers learned how to teach about energy to elementary level students. The findings will be piloted to the students at the vocational school. Then it also will be piloted to the vocational school teachers, through workshop, about the methodology that can be applied in teaching about energy.

All the teams observed the facilities and systems related to the environment in order to increase the knowledge and insight. From the results of the visit, there are many new alternative solutions. Indonesia deals with a lot of problems related to the environment and it is required solutions that can be applied as a model in many other areas.

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